Late-successional and Old-growth Vegetation Effectiveness Monitoring Northwest Forest Plan

2001 Annual Summary Report

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Final Version: April 23, 2002

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Executive Summary

This report is the first annual summary of activities accomplished by the Late-successional and Old-growth (LSOG) Module of the Interagency Regional Monitoring Program. The purpose of the LSOG Monitoring Module is to assess the status and trends of LSOG to determine if the Northwest Forest Plan will achieve the planned goals and objectives for protecting and enhancing late-successional and old-growth forest and related species on Federal lands in the range of the northern spotted owl.

Major components of the LSOG Monitoring Module are 1) mapping of existing vegetation from remote sensing, 2) estimation of LSOG amounts and characteristics from statistical analysis of inventory data, and 3) change detection and trend analysis. This report summarizes the activities and progress made in fiscal year (FY) 2001 in these major areas.

The primary objective of mapping is to generate consistent, accurate coverage of existing forest vegetation for all lands in the Northwest Forest Plan area. The Interagency Vegetation Mapping Project (IVMP) maps lands by physiographic province in Oregon and Washington, and the CALVEG project maps lands by physiographic province in California. Wall-to-wall vegetation maps will be analyzed to evaluate the amounts (acres) and distribution (stand size and arrangement) of LSOG across the Plan area landscape. IVMP maps have been completed for 5 of 9 provinces, with a target completion date of December 31, 2002 for all provinces. Completed CALVEG maps for the 3 California provinces were released in 2000, and a first update incorporating 5-yr change is being prepared for release this spring.

Statistical analysis of stand-scale plot data provides information about LSOG structural attributes and composition that remote sensing cannot detect. It can also be used to report LSOG amounts at regional scales (acres by forest condition class) with a known degree of statistical reliability. Statistical relationships between mapped vegetation attributes and sample-based measurements can be used to describe structural condition of vegetated landscapes at regional scales. The LSOG Monitoring program relies on existing permanent grid plot inventory programs to provide these data-- Forest Inventory and Analysis program (FIA), and Current Vegetation Survey (CVS). Statistical analysis has been piloted for CVS databases for classifying inventory plots based on plot and tree-list level attributes into LSOG classes using Regional Interim definitions. A unified approach to incorporate FIA data is being developed this spring.

Monitoring for trends requires establishment of baseline conditions, and a means of tracking changes from the baseline. Change detection tracks losses and gains in forest conditions from a variety of sources—management, natural succession, wildfire, insects and diseases. Remote sensing change detection will be used to track large-scale changes (stand-replacing disturbances) at periodic intervals (approximately every 5 years). California assesses change as a part of their integrated mapping, inventory, and mapping program. A remote sensing change detection program has been initiated in Oregon and Washington to provide complete information for the NWFP area. Change layers for western Oregon will be completed by October 2002, and for western Washington by April 2003.

2001 marked a major milestone for LSOG Monitoring program planning and development. An LSOG Effectiveness Monitoring module Lead was hired in December 2000. In 2001, a draft LSOG Implementation Strategy was prepared to plot an overall approach to monitoring LSOG (Moeur 2001). The Implementation Strategy discusses short and long-term program objectives, major analytic approaches, plots a course for benchmarking progress, annual and periodic reporting of LSOG monitoring, and program management needs such as staffing and budgeting.

No province or range-wide analyses were scheduled or conducted in FY 2001 for any of the LSOG Monitoring program elements. In 2001, major progress in LSOG Monitoring was gained toward completing an existing vegetation map layer, launching change detection work, and beginning the assembly and analysis of grid plot inventory databases. Full-scale analysis will begin in FY 2002 using vegetation maps completed and analytical approaches developed in FY 2001

A full Monitoring Interpretive Report is scheduled for completion in 2004. The LSOG portion of that report will contain a complete analysis of baseline conditions summarized from completed existing vegetation maps and from first-occasion grid plot inventory data. It will also contain a first approximation of trends (observed changes from baseline condition) using available updated map and inventory information. It will address interpretive links between LSOG monitoring results and the expectations of the plan to address management-related questions, such as the efficacy of the Late-Successional Reserve network.

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Introduction

The goal of Effectiveness Monitoring is to evaluate the success of the Northwest Forest Plan (NWFP) in protecting and enhancing late-successional and old-growth forest and related species on Federal lands in the range of the northern spotted owl. The Interagency Monitoring Program assesses trends and status in forest conditions and related wildlife habitat and socioeconomic conditions. The purpose of the Late-successional and Old-growth (LSOG) Monitoring Module is to assess the status and trends of LSOG to determine if the Plan will achieve the planned goals and objectives for maintaining and restoring LSOG forests (Hemstrom and others 1998). Establishment of forest baseline conditions coupled with periodic assessment of changes from the baseline are the primary elements of LSOG Effectiveness Monitoring.

Monitoring objectives and questions

- How much late-successional and old-growth forest is there on Federal land in the range of northern spotted owl?

- What is its pattern across the landscape? Across the network of lands allocated as Reserves?

- Is the amount changing? How fast? Why?

- Is the Northwest Forest Plan providing for conservation and management of late-successional and old-growth forests as anticipated?

Table 1 lists the specific monitoring objectives and questions to be addressed by the LSOG Effectiveness Monitoring Plan. The questions address LSOG *status* (amount and distribution) and *trends* (observed versus expected changes) at *landscape* and *stand* scales.

The cornerstones of the LSOG Effectiveness Monitoring strategy are 1) mapping of existing vegetation from remote sensing, 2) estimation of LSOG amounts and characteristics from statistical analysis of interagency inventory data, and 3) change detection and trend analysis. This report summarizes the activities and progress made in fiscal year (FY) 2001 in these major areas.

Table 1. Summary of Effectiveness Monitoring objectives and questions for late-successional and old-growth forests.

Monitoring Objective	Monitoring Questions
Assess the amount and distribution of late-successional and old-growth (LSOG) forests.	What are the amount and distribution of forest classes, including LSOG, at the landscape scale, and at the stand scale? ◦ For the region by land management allocation? ◦ Within physiographic province by plant community? What are the structure and composition characteristics of forest classes, including LSOG, at the stand scale? ◦ Distribution of large trees, snags, down woody debris, canopy structure? What are the landscape metric distribution parameters of forest classes, including LSOG, at the large landscape scale? ◦ Distributions of stand sizes, stand interior areas, edges, and interstand distances? What is the error associated with these estimates?
Compare the observed status and trends of LSOG with those expected under the Forest Plan to assess whether Forest Plan goals and objectives are being met.	How is the amount and distribution of forest classes, including LSOG, changing at the landscape scale, and at the stand scale? ◦ How have they changed since the last measurement cycle? ◦ How much are they likely to change in the future (near-term and long-term)? ◦ Is the trend within NWFP expectations? ◦ How do pre-and post-NWFP LSOG trends compare? What changes are produced by stressors in the amount and distribution of forest classes? ◦ What are the gains from growth and succession? ◦ What are the losses from logging, fire, wind, insects, and disease? ◦ What are the ramifications of these changes to future trends in LSOG classes?

Methods

The Monitoring Plan recommended that LSOG be examined from two perspectives. Landscape LSOG patterns could only be determined from large scale maps of existing vegetation and ancillary spatial information, while LSOG stand scale characteristics could only be determined from detailed vegetation surveys. Analysis of LSOG from vegetation maps vs. inventory data are expected to yield complementary, but different estimates because they use different attributes and definitions at different scales (Hemstrom and others 1998).

Existing Vegetation Mapping

Monitoring LSOG in the NWFP area is dependent on an accurate baseline of existing forest conditions at the start of the Plan. The LSOG Effectiveness Monitoring Plan argued the need for consistent and continuous coverage of existing forest vegetation maps created from remote sensing data (Hemstrom and others 1998). This landscape-scale look at the Plan area would provide a baseline estimate of LSOG landscape-level conditions at the beginning of the Plan, and from which future changes could be benchmarked.

The primary objective of mapping is to generate consistent, accurate coverage of existing forest vegetation for all lands in the Northwest Forest Plan area. Separate mapping projects have been launched in California and in Washington/Oregon to map forests in the Plan Area using satellite imagery from Landsat Thematic Mapper (TM) and other spatial data to classify primary attributes of forest vegetation—forest type, size, and canopy cover. Vegetation is mapped in compliance with established standards to assure its utility to mid-scale monitoring (Vegetation Strike Team, 1995, 1996). These wall-to-wall maps can then be analyzed in conjunction with other spatial data and ground-based sample data to evaluate the amounts (acres) and distribution (stand size and arrangement) of forest condition classes, including LSOG, across the Plan area landscape.

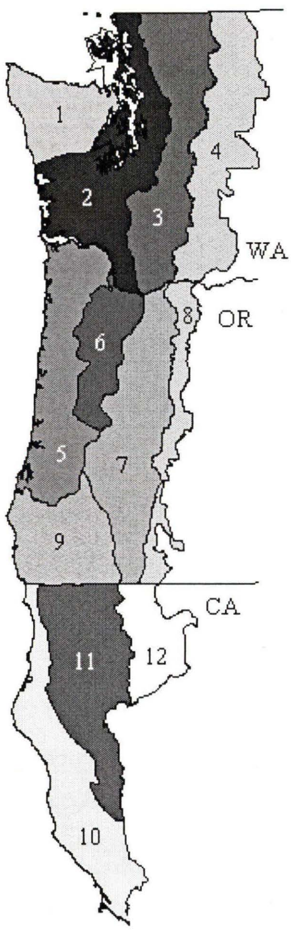
The NWFP Area is very diverse in terms of vegetation, topography, soil, and geomorphology. To reduce variability, the area to be mapped was stratified into twelve physiographic provinces (Figure 1). The Interagency Vegetation Mapping Project (IVMP) in Washington and Oregon, and CALVEG program in California develop maps of canopy cover, size, and forest type for each of the physiographic provinces comprising the NWFP area.

Interagency Vegetation Mapping Project (IVMP) in Oregon and Washington (http://www.or.blm.gov/gis/projects/vegetation/ivmp/index.asp)

The IVMP mapping program was initiated in FY 1998 through an interagency effort to provide consistent monitoring information for the Northwest Forest Plan. The BLM and USFS jointly manage and fund the IVMP program. Spatial analysts under contract with Titan, in cooperation with researchers at the Forest Service's Pacific Northwest Research Station, provide the technical expertise and map production staff. IVMP Team members are listed on the cover page.

The IVMP modeling approach combines remotely sensed satellite imagery (Landsat TM), digital elevation models (DEMs), and aerial photo interpretation to classify existing vegetation. It uses USFS and BLM Current Vegetation Survey (CVS), and Forest Inventory and Analysis (FIA) inventory plot information as reference data for model building and accuracy assessment. The

final IVMP products are four separate map themes: percent total vegetation cover, percent conifer cover, percent broadleaf cover, and size (quadratic mean diameter [QMD] of the overstory) predicted for 25-m pixels. Predicted values are of cover and QMD are continuous; cover is predicted in 1% classes from 0 to 100 percent; and QMD in 1" diameter classes from 0 to 75 inches. Image classification details and map accuracy assessments are given in IVMP documentation produced for each Physiographic Province (O'Neil and others, 2001, Browning and others, 2002).



Physiographic Provinces

1. Washington Olympic Peninsula
2. Washington Western Lowlands
3. Washington Western Cascades
4. Washington Eastern Cascades
5. Oregon Coast Range
6. Oregon Willamette Valley
7. Oregon Western Cascades
8. Oregon Eastern Cascades
9. Oregon Klamath
10. California Coast Range
11. California Klamath
12. California Cascades

Figure 1. Maps of existing forest vegetation are created for the twelve Physiographic Provinces in the Northwest Forest Plan area. Mapping falls under two projects—IVMP in Washington and Oregon, and CALVEG in California.

CALVEG Mapping in California
(http://fsweb.rsl.r5.fs.fed.us/veg_mapping/index.html)
The Pacific Southwest Region of the USFS has lead responsibility for providing the vegetation maps for Northwest Forest Plan monitoring in Northwestern California. The work is conducted by the Ecosystem Planning Staff at the Remote Sensing Lab in Sacramento, who integrate vegetation mapping, inventory, and monitoring in California. CALVEG Team members are listed on the cover page.

California's wildland vegetation (USDA Forest Service 1981, 2000) is mapped by life form, species types, size, and canopy closure. CALVEG is a stand-based map, with stand polygons created though an image segmentation process from Landsat TM imagery and DEMs using FIA grid plot reference data. Minimum mapping unit is 2.5 ha. Stand polygons are labeled according to life form, species type, tree crown size, and canopy closure (10% classes) using supervised and unsupervised classification methods. Additionally, other polygon labels are provided, such as size class (mapped to Vegetation Strike Team standard) and canopy structure (single or multi-storied). The classification approach is described in Schwind and others (1999).

LSOG Spatial Analysis
IVMP and CALVEG provide vegetation maps of certain attribute, such as size and cover, classified to various resolutions (pixels for IVMP, stand polygons for CALVEG). They are not themselves maps of specific forest condition classes, such as LSOG. LSOG maps (or for that matter, spotted owl habitat or marbled murrelet habitat maps) can be derived by applying a specific set of definitions to existing vegetation maps, perhaps in conjunction with other data sources. A process for creating an LSOG map from IVMP in Washington/Oregon, and from CALVEG in California, is in initial stages of design and testing.

The LSOG Monitoring Plan (Hemstrom and others 1998) provided a landscape-scale rule set, or set of definitions, to apply to the existing vegetation maps to derive a secondary map depicting LSOG (Appendix I). The rule set defines 19 exclusive forest condition classes based on canopy cover, QMD, canopy structure, and conifer/hardwood composition. Structure classes 8-19 (QMD > 20 inches) qualify as late-successional or old-growth forest.

There is a challenge associated with deriving a seamless LSOG map across the entire NWFP area from two inherently different map types: IVMP (pixels) and CALVEG (stand polygons). CALVEG polygons may be need to be aggregated into LSOG classes; and IVMP pixels will need to be converted into LSOG classes through an aggregation approach to simplify the inherent "salt and pepper" nature of pixel classifications. The LSOG spatial analysis will test alternative methods for processing the CALVEG and IVMP maps. Julie Browning (Titan) and Melinda Moeur (LSOG Module Lead) are leading this project.

Once LSOG maps are generated, they will be evaluated for landscape patterns. Analysis will be designed around questions such as: What are the distributions of stand sizes; stand interior areas, edges, and inter-stand distances? By measuring observed landscape patterns against expected outcomes defined in terms of Abundance, Diversity, and Connectivity targets from the LSOG Monitoring Plan (Tables 3 and 4 in Hemstrom and others 1998), the landscape metric results can provide critical information to managers for decision making. An example of such a

management questions is, Are the requirements for amount and distribution of LSOG being met by the Northwest Forest Plan, especially in the Late Successional Reserve (LSR) network?

Statistical Analysis of Inventory Plot Data

Detailed vegetation survey information collected on corporate inventory plots provides information about stand-scale LSOG structural attributes and composition that remote sensing cannot detect, such as tree size distributions, snags and down woody debris, and canopy layering. Analysis of stand-scale plot data provides information about LSOG structural attributes and composition. It can also be used to report LSOG amounts at regional scales (acres by forest condition class) with a known degree of statistical reliability. Statistical relationships between mapped vegetation attributes and sample-based measurements can be used to describe structural condition of forested landscapes at regional scales.

The LSOG Monitoring program relies on existing vegetation survey programs to provide these data. These data are from permanent grid plot inventory programs. The Forest Inventory and Analysis program (FIA) managed by the Pacific Northwest Research Station of the USFS samples vegetation across all ownerships on a ten-year cycle, using a sampling intensity of one plot for every 6000 acres. The Current Vegetation Survey (CVS) adds additional vegetation inventory information on National Forests and Bureau of Land Management Districts in Washington and Oregon. CVS plots are remeasured on a 12-year inventory cycle. Region 5 maintains additional inventory plots in California.

Application of stand-scale LSOG definitions based on structural attributes to grid plot data can complement mapped LSOG estimates based on landscape scale definitions. Operational definitions for old growth are published in draft form in Region 5 and Region 6 by vegetation series (USDA Forest Service, 1992; 1993). The definitions are based on a set of structural criteria defining minimum thresholds for large number of trees per acre, number of canopy layers, and amount of standing snags and down wood. An example is shown in Appendix II for Douglas-fir series in Region 6.

Stand-scale attribute prototype

An approach has been developed for classifying inventory plots based on plot and tree-list level attributes into LSOG classes using these Regional Interim definitions. The choice of attributes to compute and report are those needed for evaluating the conditions on the plot required to classify it as old growth, as well as important structural attributes for summarizing LSOG stand-scale characteristics. A draft list of these is shown in Table 2. The prototype analysis has been developed for CVS plot data.

Table 2. Examples of tree-level and plot-level attributes computed for stand-scale LSOG definitions and summarization of structural characteristics.

Attributes
Diameter distributions (tree per acre by dbh class)
Live trees Snags Number of down logs by diameter class
Size
Quadratic mean diameter of trees in dominant and codominant crown classes Quadratic mean diameter of all live trees
Age
Age class distribution Average age of dominant and codominant trees Age of the oldest tree measured on the plot
Species Composition
Proportion of canopy cover by conifers/hardwoods
Stand structure
Percent canopy cover Number of canopy strata FVS "Structure Class" Distribution of large crown widths Largest crown width on the plot in feet
Stand summary variables
Basal area, Trees per acre, Stand density index
Plot attributes
Slope, Aspect, Elevation Plant association, Series Geographic coordinates Administrative location Federal land use allocation

Change Detection and Trend Analysis

Monitoring for trends requires establishment of baseline conditions, and a means of tracking changes from the baseline. The goal of change detection is to track losses and gains in forest conditions from a variety of sources such as management, natural succession, wildfire, and insects and diseases. Changes can be tracked at various spatial scales and time intervals. LSOG monitoring plans to monitor change in several ways. Remote sensing change detection provides a periodic means to detect stand-replacing disturbances such as harvest and wildfire. Changes due to growth and succession will be tracked on remeasured inventory plots. Analysis of agency activity records, fire perimeter boundaries, and aerial insect and disease surveys will be used to integrate information about less frequent or less severe disturbances. Expected trends will be refined using predictive models designed to simulate ecological processes under different management and disturbance scenarios at stand and landscape scales.

Remote Sensing Change Detection
(http://frap.cdf.ca.gov/projects/change_detection/changedetectfr.html**)**
(http://www.fsl.orst.edu/larse/wov/88wov.html**)**
Remote sensing will be used to track large-scale changes (stand-replacing disturbances) at periodic intervals (approximately every 5 years). Remote sensing change detection is sensitive to land cover changes resulting from regeneration harvest and land use conversion, severe wildfire, and severe insect and disease outbreaks. Remote sensing cannot detect less severe disturbances, or more disturbances that occur more frequently than the mapping interval.

Remote sensing change detection analyzes differences in paired satellite images captured at 5-year intervals to map the location, magnitude, and direction of change; and subsequently labels the causes of change by integrating other data sources like aerial photos, agency activity records, fire perimeter boundaries, insect and disease surveys.

Change detection work in the California portion of the Northwest Forest Plan area is conducted by the Remote Sensing Lab under their integrated mapping, monitoring and inventory program. In Washington and Oregon, the change detection work is being conducted by the Pacific Northwest Research Station (PNW) in Corvallis. Change Detection Team members are listed on the cover page.

Agency Activity Records
Records of agency activities can be assembled annually from field unit information. Annual information about activities such as partial harvest and thinning, prescribed fire, and restoration will be helpful to the LSOG Monitoring program for tracking less severe and/or more frequent changes. Typically, this information will be available in tabular form (for example, the number of acres treated by administrative unit), and may be available in spatial form as well. The LSOG Module will rely on decisions made by the overall Monitoring Program to determine the extent to which an integrated database of agency activities will be assembled, maintained, and made available for annual analysis.

Analysis of Remeasured Inventory Plots
Analysis of stand-scale information on remeasured permanent plots provides a statistical sample reflective of annual changes in forest conditions at the full range of disturbance scales—from

stand loss due to management or natural disturbance, to successional change resulting from ingrowth, growth, and mortality. Analysis of change on permanent plots is inherently limited by the fact that inventory grid plots are remeasured on a long cycle (for example, 10% of FIA plots are remeasured annually, with a complete cycle every 10 years); thus, knowledge about change is only partial in any given year because the sample of remeasured plots is always incomplete.

The Inventory Data Team will design the analysis of remeasured plot data, relying heavily on the technical experience of the FIA unit at PNW Research Station. Inventory Data Team members are listed on the cover page.

Refined trend analysis

The key to analyzing the effectiveness of the NWFP in meeting LSOG goals (short-term and long-term) is to be able to compare observed changes with trends expected under the activities, standards, and guidelines established in the NWFP Record of Decision. For LSOG, those expected trends were estimated only very coarsely in terms of acres of LSOG expected to be present on the landscape by decade. LSOG Monitoring will employ simulation models applied to baseline data to refine expected trends. Models for advancing (i.e. projecting) the landscape (using map data) and individual stands (using inventory plot data) are well accepted in the natural resources planning community. Examples are Vegetation Dynamics Development Tool (VDDT) at the landscape level and Forest Vegetation Simulator (FVS) at the stand scale. Both types of models can produce realistic projections of future changes under various assumptions of planned management activities and natural disturbance probabilities.

Results

Existing Vegetation Mapping

Interagency Vegetation Mapping Project (IVMP) in Oregon and Washington
As of March 30, 2002, IVMP data has been released for five provinces—Oregon Coast Range, Western Oregon Cascades, Olympic Peninsula, Western Washington Lowlands and Western Washington Cascades (Figure 2). IVMP thematic map data, documentation and accuracy assessment are distributed on CD (Browning and others 2002; O'Neil and others 2001) and are also downloadable from a BLM website (http://www.or.blm.gov/gis/projects/vegetation/). Eastern Washington Cascades is 80% completed. Target completion date for all remaining provinces (Eastern Oregon Cascades, Oregon Klamath, and Willamette Valley) is by end of CY 2002.

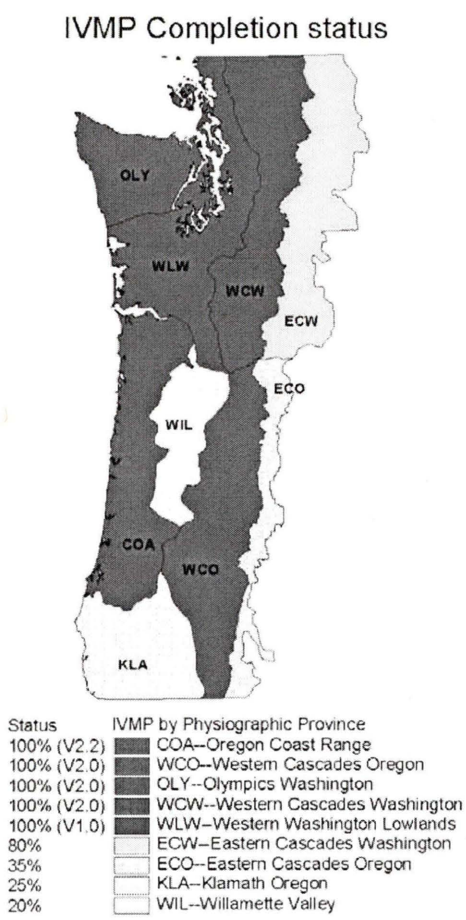


Figure 2. IVMP completion status, as of March 30, 2002.

CALVEG Mapping in California
Completed CALVEG maps for Northwestern California provinces were released in late 2000 (Schwind and others 1999; USDA Forest Service 2000, and website at fsweb.rsl.r5.fs.fed.us/veg_mapping/index.html). The Inventory and Monitoring group at the R5-Remote Sensing Lab (RSL) have recently completed the first map update for Northwestern California incorporating change detection results and map edits. An updated layer is significant in that it is the first example of vegetation monitoring data available for two different points in time. This will make it possible to design a pilot approach to estimating change in LSOG at the landscape scale by comparing differences in the baseline and updated maps.

LSOG Spatial Analysis
A work plan has been written to pilot test an LSOG spatial analysis approach. Two test areas have been chosen for which independent ground truth data is available to validate the creation of LSOG classes from IVMP map data (the Alsea project area in the Oregon Coast Range province, and HJ Andrews Experimental Forest in the Western Cascades Oregon province). Spatial and tabular data are being compiled currently, and pilot analysis will begin in late Spring 2002 with a target completion date of September 2003.

Statistical Analysis of Inventory Plot Data
A pilot approach for computing tree-level and stand-level attributes for stand-scale analysis of LSOG and classification of plot data into LSOG classes has been completed and demonstrated for a portion of the CVS data (the entire Mt. Hood National Forest). The next step in refining this process is to test the approach on FIA data. A meeting with FIA scientists has been scheduled in early April 2002 to begin working on accessing FIA databases and developing a unified approach for processing FIA and CVS plot data. This includes analysis of periodic change derived using the current subsample of second occasion measurement plots. The first Interagency Monitoring Interpretive Report to be completed in 2004 will analyze data collected as late as field season 2002. By 2002, some 60% of CVS plots will have been remeasured on R6 National Forest lands, 25% of CVS plots on BLM lands, and virtually all FIA plots on private and state lands.

Remote Sensing Change Detection
As mentioned above, change detection results for California have been incorporated into a second occasion update layer (Levien and others 2002). In Washington and Oregon, a remote sensing change detection project has been initiated. Dr. Warren Cohen, PNW-Corvallis, had previously completed change layers for western Oregon for the period from 1972 to 1995 (Cohen and others in press). Under a Cooperative Research Agreement, Dr. Cohen will lead production of change layers for western Oregon for the period 1985 to 2003, and for Western Washington from 1985 to 2003. This will enable an approximately decadal retrospective look at change prior to the start of the Plan, and in the first subsequent decade. The Agreement calls for delivery of completed change maps for western Oregon in October 2002, western Washington in April 2003, and eastern Oregon and Washington (areas within the Northwest Forest Plan) in September 2003.

Inclusion of a remote sensing change detection component for vegetation monitoring represents a strategic departure from initial module design. Although never stated explicitly, the original design implied that existing vegetation would be mapped at repeated intervals. That is, it was envisioned that an IVMP effort would be repeated perhaps every ten years. By incorporating a change detection approach, the existing vegetation maps representing the landscape at the beginning of the NWFP can be used as a baseline of conditions that can be continually updated using change layers.

Discussion

No province or range-wide analyses were scheduled or conducted in FY 2001 for any of the LSOG Monitoring program elements. In 2001, major progress in LSOG Monitoring was gained toward completing an existing vegetation map layer, launching change detection work, and beginning the assembly and analysis of grid plot inventory databases. Full-scale analysis will begin in FY 2002 using vegetation maps completed and analytical approaches developed in FY 2001

Existing vegetation mapping and LSOG spatial analysis will be used to produce spatially explicit estimates of amounts and distribution of LSOG. Its products, in addition to baseline vegetation maps, will be an LSOG map, analysis of landscape metrics, and spatial trend projections.

Statistical analysis of grid plot data will result in statistically reliable estimates of amounts and distribution of LSOG, assessment and characterization of stand-level LSOG attributes, and stand-level trend analysis, including change between measurement occasions.

Change detection from remote sensing derived at approximately 5-year intervals will be coupled with baseline vegetation and LSOG map layers to assess major change in LSOG amounts and spatial distribution.

Monitoring Program Considerations

LSOG Monitoring Program

CY 2001 marked a major milestone for LSOG Monitoring program planning and development. The LSOG Effectiveness Monitoring module formally launched in December 2000 with the filling of a full-time Lead position. While GTR-438 laid the groundwork for overall LSOG monitoring direction, no details regarding approach strategy and analysis toward addressing monitoring objectives and questions had been worked out until a permanent Module Lead was hired. The past acting LSOG leads (Miles Hemstrom, John Teply, and Tom DeMeo) had done a thorough job of setting in motion a major project for obtaining a consistent and continuous map layer of existing vegetation through an Interagency remote sensing classification project. The Interagency Vegetation Mapping Project (IVMP) was launched (and funded) in 1998 to supply existing vegetation maps for the NWFP area in Oregon and Washington. This map layer is expected to be completed near the close of CY 2002. The acting Leads also envisioned a complementary approach to estimation of LSOG amounts through analysis of existing grid plot data, although this work had not yet been begun. Upon filling a full-time, permanent LSOG module lead in December of 2000, the first major task of was to create a unified strategy for the overall LSOG monitoring program.

A draft LSOG Implementation Strategy was prepared to plot an overall approach to monitoring LSOG (Moeur 2001). The Implementation Strategy discusses short and long-term program objectives, and major analytic approaches--mapping existing vegetation, analysis of permanent grid plot inventory data, and change detection and trend analysis. It also plotted a course for annual and periodic reporting of LSOG monitoring, and program management needs such as staffing and budgeting. During the program management phase a 5-year Work Plan was also produced for completing ongoing tasks, launching new analyses, and benchmarking progress. Associated with the LSOG Work Plan was establishment and funding of Cooperative Research Agreements to support LSOG monitoring. The LSOG Monitoring Plan Implementation Strategy and LSOG Work Plan are available from the LSOG Monitoring Module Lead. Descriptions of the LSOG Monitoring components are being made available to clients and general public through an Interagency Regional Monitoring brochure (Appendix V) and website at http://www.reo.gov/monitoring.

Formal and informal team establishment was also accomplished in 2001. Technical teams were established a and convened for planning and work accomplishment. These are listed on the cover page. Formal staffing included:

A spatial analyst (supervised by Moeur in Portland) is charged with developing approaches for translating IVMP results into spatial depictions of LSOG, and for consulting on mapping need of other monitoring modules (in particular, habitat mapping for owls and murrelets, and classification of riparian and upslope vegetation for watershed monitoring).

A post-doc (to be supervised by Cohen in Corvallis) to staff the change detection program in Oregon and Washington.

2004 Monitoring Interpretive Report

All current work within the LSOG module is directed at making progress toward completion of a first-decadal Monitoring Interpretive Report to be produced in 2004. A detailed LSOG chapter

outline is being prepared in late spring 2002. The LSOG portion of the Interpretive Report will contain a complete analysis of baseline conditions summarized from completed existing vegetation maps and from first-occasion grid plot inventory data. It will contain a first approximation of trends (observed changes from baseline condition) using available updated map and inventory information. Most importantly, it will make interpretive links between LSOG monitoring results and the expectations of the plan to address management-related questions, such as the efficacy of the Late-Successional Reserve network A general outline is presented in Figure 3.

I. ASSESSMENT OF STATUS AND TRENDS

- *A.* Late Succession Old Growth Forests
  1. Assessment of Forest Vegetation
     - a) Sources of data and classification
     - b) Monitoring results
       - i) Distribution and amount of forest classes - monitoring questions
       - ii) Stand characteristics - monitoring questions
       - iii) Changes over 10 year period
     - c) Evaluation of external data and research
  2. Comparison to expectations of the Forest Plan
     - a) Expectations of forest plan (short-term and long-term)
     - b) Comparison to expectations

Figure 3. General outline for LSOG chapter of 2004 Monitoring Interpretive Report.

Recommendations for upcoming field season

Full-scale analysis will begin in FY 2002 using vegetation maps completed and analytical approaches developed approaches in FY 2001. The full Monitoring Interpretive Report is scheduled for completion in 2004. The LSOG portion of that report will contain a complete analysis of baseline conditions summarized from completed existing vegetation maps and from first-occasion grid plot inventory data. It will also contain a first approximation of trends (observed changes from baseline condition) using available updated map and inventory information.

The LSOG module will take on an additional role as technical consultant for spatial and map analysis for the other Monitoring Modules (especially Northern Spotted Owl, Marbled Murrelet, and Watershed Monitoring). LSOG will develop pilot approaches and provide guidance for developing rule sets and image processing techniques for deriving LSOG, owl habitat, murrelet habitat, and watershed vegetation conditions from IVMP, CALVEG, and other map data.

A related function of the LSOG module will result from its evolving capability to compile old-growth acres for Regional reporting needs, such as responding to Congressional inquiries, coordinating planning efforts, etc. An Old Growth task group (listed on Cover page) has been convened to work out a process for agreeing on operational definitions and discuss attribute sets for summarizing old growth acreages. Planned progress toward analyzing interagency inventory data is on track to tally and report old growth acreages by the end on 2002.

Literature Cited

Browning, J..; Kroll, KC; Grob, C.; Ducey, C.; Fassnacht, K.; Alegria, J.; Nighbert, J; Moeur, M.; DeMeo, T; Fetterman, J.; Weyermann, D. February 2002. Interagency Vegetation Mapping Project (IVMP). Olympic Province Version 2.0. 37 p.

Browning and others. February 2002. Accuracy assessment for the Interagency Vegetation Mapping Project (IVMP). Olympic Province Version 2.0. 36 p.

Browning and others. 2002. Interagency Vegetation Mapping Project (IVMP). Western Washington Cascades Province Version 2.0. xx p.

Browning and others. 2002. Accuracy assessment for the Interagency Vegetation Mapping Project (IVMP). Western Washington Cascades Province Version 2.0. xx p.

Browning and others. 2002. Interagency Vegetation Mapping Project (IVMP). Western Washington Lowlands Province Version 2.0. xx p.

Browning and others. 2002. Accuracy assessment for the Interagency Vegetation Mapping Project (IVMP). Western Washington Lowlands Province Version 2.0. xx p.

Cohen, W.; Spies, T.; Alig, R.; Oetter, D.; Maiersperger, T.; Fiorella, M. In press. Characterizing 23 years (1972-1995) of stand replacement disturbance in western Oregon forests with Landsat imagery. Ecosystems.

Hemstrom, Miles, Thomas Spies, Craig Palmer, Ross Kiester, John Teply, Phil McDonald, and Ralph Warbington. 1998. Late-successional and old-growth forest effectiveness monitoring plan for the Northwest Forest Plan. Gen. Tech. Rep. PNW-GTR-438. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 37 p.

Levien, L.; Chris Fischer, C.; Pete Roffers, P.; Barbara Maurizi, B.; James Suero, J.; January 2002. Monitoring Land Cover Changes in California. California Land Cover Mapping and Monitoring Program. *Northeastern California Project Are.* Report published on the World Wide Web. 171 p.
http://frap.cdf.ca.gov/projects/land_cover/monitoring/pdfs/northeastern_ca_report.pdf

Moeur, Melinda. May 2001. Implementing an Effectiveness Monitoring Plan for Late-Successional and Old-Growth Forests in the NWFP Area. Report on file, R6-Regional Office, Interagency Effectiveness Monitoring Program.

O'Neil, J.; Kroll, KC; Grob, C.; Ducey, C.; Fassnacht, K.; Alegria, J.; Nighbert, J; Moeur, M.; DeMeo, T; Fetterman, J.; Weyermann, D. September 2001. Interagency Vegetation Mapping Project (IVMP). Oregon Coast Province Version 2.2. Published to CD. 39 p.

O'Neil and others. September 2001. Accuracy assessment for the Interagency Vegetation Mapping Project (IVMP). Oregon Coast Province Version 2.2. Published to CD. 22 p.

O'Neil and others. April 2001. Interagency Vegetation Mapping Project (IVMP). Western Oregon Cascades Province Version 2.0. 38 p.

O'Neil and others. April 2001. Accuracy assessment for the Interagency Vegetation Mapping Project (IVMP). Western Cascades Oregon Province Version 2.0. 60 p.

Schwind, B., R. Warbington, C. Curlis, S. Daniel. (1999). Creating A Consistent and Standardized Vegetation Database for Northwest Forest Plan Monitoring in California: Proceedings of the 1999 ASPRS Annual Conference. Portland, OR. pp. 354-362. (http://www.krisweb.com/biblio/general/usfs/warbingtonetal.htm).

USDA, U.S. Forest Service - Regional Ecology Group. 1981. CALVEG: A Classification of California Vegetation. San Francisco, CA. 168 pp.

USDA Forest Service. 1992. Old Growth Definitions/Characteristics for Eleven Forest Cover Types. Internal memo dated June 19, 1992, USDA Forest Service, Pacific Southwest Region, San Francisco, CA.

USDA Forest Service. 1993. Region 6 interim old growth definition[s] [for the] Douglas-fir series, grand fir/white fir series, interior Douglas-fir series, lodgepole pine series, Pacific silver fir series, ponderosa pine series, Port Orford cedar series, tanoak (redwood) series, western hemlock series. USDA Forest Service, Pacific Northwest Region, Portland, OR.

USDA Forest Service. 2000. Existing Vegetation: Region 5 Vegetation Data Geobook. R5 Remote Sensing Lab. Sacramento, CA.

Vegetation Strike Team. 1996. Data standards and implementation recommendations. Internal document. Interagency Resource Information Coordinating Committee. USDA Forest Service and USDI Bureau of Land Management, Portland, OR.

Vegetation Strike Team. 1995. Interagency vegetation information: data needs, standards, and implementation next steps. Portland, OR: USDA Forest Service; USDI BLM; Interagency Resource Information Coordinating Committee. 21 p.

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Website

Descriptions of the Monitoring modules are available to clients and the general public through an Interagency Regional Monitoring website at http://www.reo.gov/monitoring.

A Glossy brochure featuring highlights of Monitoring Program elements is also available from USDA Forest Service, Pacific Northwest Region, Public Affairs Office.

Appendix I

Landscape-scale definitions of forest condition classes to apply to the existing vegetation maps (modified from Hemstrom and others [1998], Table 1).

	Composition class		
Structure class	**Deciduous (D)**	**Mixed (M)**	**Conifer (C)**
Potentially forested	PF	PF	PF
Seedling and sapling	SS-D	SS-M	SS-C
Small single-storied	SSS-D	SSS-M	SSS-C
Medium to large single-storied	MSS-D	MSS-M	MSS-C
Medium to large multistoried	MMS-D	MMS-M	MMS-C
Large single-storied	LSS-D	LSS-M	LSS-C
Large multistoried	LMS-D	LMS-M	LMS-C

		Class Definitions			
Class Number	**Structure Class**	**Canopy Cover (%)**	**DBH (inches)**	**Canopy Structure**	**Species Mix**
1	PF	< 10	NA	NA	NA
2	SS-D	>10	0-10	any	> 80% Deciduous
3	SS-M	>10	0-10	any	20%-80% Either
4	SS-C	>10	0-10	any	> 80% Conifer
5	SSS-D	>10	10-20	any	> 80% Deciduous
6	SSS-M	>10	10-20	any	20%-80% Either
7	SSS-C	>10	10-20	any	> 80% Conifer
8	MSS-D	>10	20-30	simple	> 80% Deciduous
9	MSS-M	>10	20-30	simple	20%-80% Either
10	MSS-C	>10	20-30	simple	> 80% Conifer
11	MMS-D	>10	20-30	complex	> 80% Deciduous
12	MMS-M	>10	20-30	complex	20%-80% Either
13	MMS-C	>10	20-30	complex	> 80% Conifer
14	LSS-D	>10	>30	simple	> 80% Deciduous
15	LSS-M	>10	>30	simple	20%-80% Either
16	LSS-C	>10	>30	simple	> 80% Conifer
17	LMS-D	>10	>30	complex	> 80% Deciduous
18	LMS-M	>10	>30	complex	20%-80% Either
19	LMS-C	>10	>30	complex	> 80% Conifer

Appendix II

R6 Interim Old Growth stand-scale definitions for Douglas-fir series translated into class characteristics (USDA Forest Service 1993).

				Live Trees			Standing Dead		Down Dead	
Type	Site Class	Plant Assoc. (1)	Area (2)	Min. DBH"	Trees per Acre	Canopy Layers	Min DBH	TPA	Diam	# Pieces
Douglas-fir (west)	1-3	CD* (1a)	West	37	8	2	13	1	24	4
Douglas-fir (west)	4	CD* (1a)	West	34	9	2	15	1	24	4
Douglas-fir (west)	5	CD* (1a)	West	24	10	2	17	1	24	4
Douglas-fir (interior)	all	CD* (1b)	East	21	8	1	12	1	12	2

```
(1) Plant Associations:
    1a) Douglas-fir (West):      CDS212  CDS213  CDS5*   CDS1*   CDF0*
        CDC5*   CDS241  CDC712  CDC3*   CDH1*   CDH5    CDS221  CDS211
        CDS641  CDS255  CDS5*   CDS651  CDS662

    1b) Douglas-fir (Interior): CDG131  CDS811  CDS813  CDG111  CDG1
        CDG121  CDG141  CDG321  CDS632  CDS623  CDS411  CDS715  CDS711
        CDS716  CDS722  CDS814  CDS231  CDS812  CDG123  CDS633  CDS661
        CDS622  CDS634  CDS612  CDS613  CDS614

 (2) Area:
        West   = SIS ROR UMP WIL MTH GIP MBS OLY
        East   = DES OKA SIU WEN WIN
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Appendix III - Quality Assurance summary

Detailed Quality Assurance plans are published with documentation for IVMP and CALVEG. These address data collection and quality, data screening, and precise flowcharts for processing image data for the creation of existing vegetation layers.

Detailed Quality Assurance plans are published with documentation for CVS and FIA inventory programs. These address data collection and compilation, peer review and reconciliation of research study plans and publications.

Appendix IV – Glossary of Acronyms

BLM – Bureau of Land Management
CALVEG - Classification and Assessment with Landsat of Visible Ecological Groupings
CVS – Current Vegetation Survey
DEM - Digital elevation model
FIA – Forest Inventory and Analysis
IVMP - Interagency Vegetation Mapping Project
LSOG - Late-successional and old-growth
LSR - Late Successional Reserve
NWFP - Northwest Forest Plan
PNW - USDA Forest Service, Pacific Northwest Research Station
R5 – USDA Forest Service, Pacific Southwest Region (Region 5)
R6 – USDA Forest Service, Pacific Northwest Region (Region 6)
RSL - USDA Forest Service, R5-Remote Sensing Lab
QMD - Quadratic mean diameter
TM- Landsat Thematic Mapper
NWFP - Northwest Forest Plan
USFS – United States Forest Service

Budget

FY 2001 LSOG Monitoring Module budget

Function	2001 Budget (thousands)		
	Total	R-6	BLM
LSOG Program Management	100	100	
IVMP	201	137	64
Spatial Analyst PNW	70	70	
Change Detection PNW	50	50	
FIA Inventory in R5	50	50	
MODULE TOTAL	471	407	64